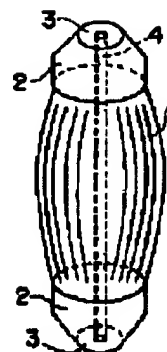


## HOLLOW-FIBER MEMBRANE MODULE

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### Abstract of JP7178320

**PURPOSE:** To allow a compact module unit to have a large membrane surface by limiting the area of the fixing member surface on the side where a hollow-fiber membrane is exposed from the fixing member and the area of the end face of the fixing member where the membrane is opened to conform to a specified relation. **CONSTITUTION:** When the area of a fixing member surface on the side where a hollow-fiber membrane 1 is exposed from the fixing member is denoted by A and the area of the end face of the fixing member where the membrane 1 is opened by B,  $100 \geq A/B \geq 1.2$  is fulfilled. The membrane 1 and the hollow-fiber membrane knitted or weaved fabric are preferably formed with a high-ductility material such as PE and PP. A housing 2 functions as a member to fix the end of the hollow-fiber membrane bundle fixed with resin. A filtrate is discharged from the open end face 3 of the membrane and sent to a water pipe, etc. A structure supporting material 4 is positioned at the center of the module and integrated with the housing 2 covering the resin-fixed part formed on both ends of the bundle membrane.



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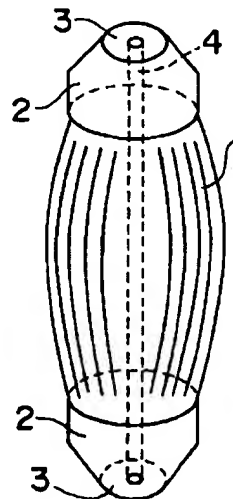
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(54)【発明の名称】 中空糸膜モジュール

(57)【要約】

【目的】 本発明は、中空糸膜の片端部或は両端部がハウジング内の固定部材で開口状態を保ちつつ固定される中空糸膜モジュールであって、中空糸膜が固定部材より露出する側の固定部材面の面積をA、中空糸膜が開口している固定部材端面の面積をBとしたとき、次式 $1.00 \geq A/B \geq 1.2$ を満足する中空糸膜モジュールである。



1

【特許請求の範囲】

【請求項1】 中空系膜の片端部或は両端部がハウジング内の固定部材で開口状態を保ちつつ固定されてなる中空系膜モジュールであって、中空系膜が固定部材より露出する側の固定部材面の面積をA、中空系膜が開口している固定部材端面の面積をBとしたとき、次式を満足する中空系膜モジュール。

$$1.00 \geq A/B \geq 1.2$$

【請求項2】 シート状の中空系膜編織物を用い、その中空系膜の片端部或は両端部が開口状態を保ちつつ構造材内の固定部材で固定され、固定部材の中空系膜に垂直な断面の形状が細長いほぼ矩形である中空系膜モジュールに於て、中空系膜が固定部材より露出する側の固定部材面の面積をA、中空系膜が開口している固定部材端面の面積をBとしたとき、次式を満足する中空系膜モジュール。

$$1.00 \geq A/B \geq 1.2$$

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は中空系膜モジュールに関し、特に汚濁性（有機性物質による汚濁性）の高い液体を濾過するのに適した中空系膜モジュールに関する。

【0002】

【従来の技術】従来、中空系膜モジュールは、無菌水、飲料水、高純度水の製造や、空気浄化といった所謂精密濾過の分野に於て多く使用されてきたが、近年、下水処理場に於ける二次処理、三次処理や、浄化槽に於ける固液分離等の高汚濁性水処理用途に用いる検討が様々な形で行われている。

【0003】このような用途に用いる中空系膜モジュールは、濾過処理時に於ける中空系膜の目詰まりが大きいために、一定時間濾過処理後、空気を送って中空系膜を振動させて膜表面を洗浄したり、濾過処理と逆方向に処理水を通水するなどの膜面洗浄を繰り返している。

【0004】これらの分野で用いられている中空系膜モジュールは、従来の精密濾過の分野に於て用いられてきた円形円状や同心状に中空系膜を集束して配置した円筒形タイプのものがほとんどであった。また、改良が施されるとしても、中空系膜の充填率や充填形態を変えるだけのものが多かった。

【0005】

【発明が解決しようとする課題】このような従来の中空系膜モジュールを用いて高汚濁性水（例えば、SS $\geq$ 50mg/L、TOC $\geq$ 100mg/L）の濾過処理を行った場合には、使用に伴い中空系膜表面に付着した有機物等の堆積物を介して、中空系膜同士が固着（接着）して一体化されることにより、モジュール内の中空系膜の有効膜面積が減少し、濾過流量の急激な低下がみられた。また、このようにして中空系膜同士が固着して一体化した中空系膜モジュールを定期的な膜面洗浄や逆洗を

2

行う場合も、一旦固着一体化したモジュールの機能回復は容易ではなく、洗浄効率の低下が見られた。

【0006】この問題の解決策として、集束型で円筒形の中空系膜モジュールに換えて、中空系膜をシート状に配置し、中空系膜の片端部或は両端部が、一つ或は異なる二つのハウジング内の固定材でそれぞれ開口状態を保ちつつ固定されてなる中空系膜モジュールであって、固定部材の中空系膜に垂直な断面の形状がいずれも細長いほぼ矩形である中空系膜モジュールが提案されている。

【0007】このようなシート状の平型の中空系膜モジュールは、中空系膜を層間隔を設けて内外層に均等に配置させることが可能となり、膜面洗浄の際、中空系膜表面を均等に洗浄することが極めて容易となるので、これまでのような濾過効率の低下を抑えることができるなど、高汚濁性水の濾過に適したモジュールである。

【0008】このような平型の中空系膜モジュールを用いて、大容量（例えば1m<sup>3</sup>/h）の水を処理する場合には膜面積を広げる必要がある。モジュールの膜面積を大きくすることによって、取扱いが困難、処理槽が必要以上に大きくなり、更に、スクラビング洗浄等を行う場合には、膜面積を増やすことによって中空系膜を集積することになり、モジュール内の膜面全体をエアー等で効率良く洗浄できないといった問題点がある。

【0009】また、従来の平型の中空系膜モジュールの使用に於ては、膜面積を増やすためにモジュール数を増やしてユニット化する方法があるが、この場合、ユニット内のモジュール配置（即ちシート状の中空系膜を重ね合わせるようにモジュールを並列させた時のモジュール間の間隔）は、それぞれのモジュールの集水管の径に支配され、モジュール間の距離を狭めるには限界がある。

【0010】従って、必要以上のモジュール間隔（シート状の平型中空系膜モジュールでは中空系膜編織物の間隔）が開き、それに伴って必要以上に処理槽の容積が大きくなったり、スクラビングのためのパブリング量を増やさなければならないという問題点がある。

【0011】本発明は、コンパクトなモジュールユニットに大きい膜面積を有するが、集水部の占めるスペースは小さく、且つモジュール内の中空系膜全体にスクラビング洗浄が効率よく実施できる中空系膜モジュールを提供することを目的とする。

【0012】

【課題を解決するための手段】本発明の要旨は次の通りである。

(1) 中空系膜の片端部或は両端部がハウジング内の固定部材で開口状態を保ちつつ固定されてなる中空系膜モジュールであって、中空系膜が固定部材より露出する側の固定部材面の面積をA、中空系膜が開口している固定部材端面の面積をBとしたとき、次式を満足する中空系膜モジュール。

$$1.00 \geq A/B \geq 1.2$$

【0013】(2)シート状の中空系膜編織物を用い、その中空系膜の片端部或は両端部が開口状態を保ちつつ構造材内の固定部材で固定され、固定部材の中空系膜に垂直な断面の形状が細長いほぼ矩形である中空系膜モジュールに於て、中空系膜が固定部材より露出する側の固定部材面の面積をA、中空系膜が開口している固定部材端面の面積をBとしたとき、次式を満足する中空系膜モジュール、

$$100 \geq A/B \geq 1.2$$

【0014】以下に本発明を図面に従い詳細に説明する。図1は、中空系膜の両端を固定部材で開口部を保ちつつ固定し、円筒形を形成した本発明の中空系膜モジュールの斜視図である。このモジュールのA/Bは4.6である。図2は、中空系膜編織物を8枚用いて、各々の中空系膜の片端部を開口状態を保ちつつ固定部材で固定した本発明の中空系膜モジュールの斜視図である。このモジュールのA/Bは1.7である。

【0015】図3は、図2と同様に中空系膜編織物を8枚用いて、各々の中空系膜の両端部を開口状態を保ちつつ固定部材で固定した本発明の中空系膜モジュールの斜視図である。図4は、図2及び図3で示したモジュールの集水管の長手方向に垂直な方向に於ける中空系膜固定部の断面図である。

【0016】1は中空系膜、2はハウジング（内部は固定部材）、3は中空系膜開口端面、4は構造支持材、5は中空系膜編織物、6はハウジング及び集水管、7は固定部材、8は導水管、9は濾液取り出し口をそれぞれ示している。

【0017】中空系膜1及び中空系膜編織物5は、例えばセルロース系、ポリオレフィン系、ポリビニルアルコール系、ポリスルホン系等の各種材料からなるものを使用でき、特にポリエチレン、ポリプロピレンなどの強伸度の高い材質のものが好ましい。

【0018】尚、濾過膜として使用可能なものであれば、孔径、空孔率、膜厚、外径等には特に制限はないが、除去対象物や容積当たりの膜面積の確保及び中空系膜の強度等を考えると、好ましい例としては、孔径0.01~1 $\mu$ m、空孔率20~90%、膜厚5~300 $\mu$ m、外径20~2000 $\mu$ mの範囲を挙げることができる。また、バクテリアの除去を目的とする場合の孔径は0.2 $\mu$ m以下であることが必須となり、有機物やウイルスの除去を目的とする場合には分子量数万から数十万の限外濾過膜を用いる場合もある。

【0019】中空系膜の表面特性としては表面に親水性基等を持つ所謂恒久親水化膜であることが望ましい。恒久親水化膜の製法としては、ポリビニルアルコール系のような親水性高分子で中空系膜を製造する方法、又は疎水性高分子膜の表面を親水化する方法など公知の方法が使用できる。例えば親水性高分子を膜面に付与し疎水性中空系膜を親水化する際の親水性高分子の例としては、

エチレン-酢酸ビニル系共重合体、ポリビニルピロリドン等を挙げることができる。

【0020】別の手法による膜面親水化の例としては、親水性モノマーの膜面重合方式があり、このモノマーの例としてはジアセトンアクリルアミド等を挙げることができる。また、他の手法としては疎水性高分子（例えばポリオレフィン）に親水性高分子をブレンドして紡糸製膜する方法を挙げることができ、使用する親水性高分子の例としては上述したものが挙げられる。

【0021】表面が疎水性の中空系膜であると、被処理水中の有機物と中空系膜表面との間に疎水性相互作用が働き膜面への有機物吸着が発生し、それが膜面閉塞につながり濾過寿命が短くなる。また、吸着由来の目詰まりは膜面洗浄による濾過性能回復も一般には難しい。

【0022】恒久親水化膜を用いると有機物と中空系膜表面との疎水性相互作用を減少させることができ、有機物の吸着を抑えることができる。更に、疎水性膜では使用中のスクラビング洗浄に於て、そのパブリングエアによって乾燥、疎水化が生じ、フラックスの低下を招くことがあるが、恒久親水化膜では乾燥してもフラックスの低下を招くことがない。

【0023】中空系膜の固定に関して、図2及び図3に示すように、中空系膜の片端或は両端のどちらでも構わない。目的や用途に応じてどちらかの固定を選択できる。中空系膜編織物5は、中空系膜をシート状に編んだ物であり、シート状中空系膜の製法としては任意の手法が用いられ、例えば、特公平4-26886号公報や特開昭63-91673号公報に記載されている装置や方法を用いると容易に製造できる。

【0024】ハウジング2は、樹脂固定してある中空系膜集束端部を固定する部材として機能する。中空系膜開口端面3は、この端面より濾液を取り出し、導水管等へ濾液を送る。構造支持材4は、中空系膜モジュールの中心部に位置しており、集束された中空系膜の両端部に形成されている樹脂固定部を覆うハウジング2と固定され一体的に形成されている。尚、この棒状の構造支持体4を管状とし、その管内を浄水の流路として利用することもできる。断面形状としては、円形、正方形、矩形等棒状であれば差し支えない。

【0025】ハウジング及び集水管6は、図2並びに図3の中空系膜モジュール全体を支持する部材として機能し、細長い、ほぼ矩形の開口部を有する。このハウジング及び集水管6の開口部は、そこに中空系膜を伴って充填固定される固定部材の中空系膜に垂直な断面の形状が細長いほぼ矩形をしたものである。

【0026】固定部材7は、ハウジング及び集水管6の開口部に充填固定されると共に、図3のような断面形状を有するように形成されるが、形状はどのようなものであっても差し支えない。この固定部材7は、多数の中空系膜の各端部を開口状態を保ったまま集束して固定され

るとともに、この中空系膜を濾過膜として機能させるために、被処理水と処理水を液密に仕切る部材として機能する。

【0027】固定部材7は、通常エポキシ樹脂、不飽和ポリエステル樹脂、ポリウレタン等の液状樹脂を硬化させて形成させる。図1のハウジング2内部の固定部材についても同様である。導水管8は、濾液が流れるパイプであり、濾液取り出し口9に通ずる。

【0028】ハウジング2、構造支持材4、ハウジング及び集水管6及び導水管8の材質としては、機械的強度及び耐久性を有するものであれば良く、例えば硬質ポリ塩化ビニル樹脂、ポリカーボネート、ポリスルホン、ポリプロピレン、アクリル樹脂、ABS樹脂、変成PPE樹脂等が例示される。使用後に焼却処理が必要な場合には、燃焼により有毒ガスを出さずに完全燃焼させることのできる炭化水素系の樹脂を材質とするのが好ましい。

【0029】中空系膜が固定部材より露出する側の固定部材面の面積Aと、中空系膜が開口している固定部材端面の面積Bの比、 $A/B$ は任意の値が選択できるが、処理容量、膜面積、缶体或は処理槽の大きさ、取扱い性等を考慮すると1.2〜100の範囲が好ましい。特に、平型の中空系膜モジュール（中空系膜編織物を使用）の場合では、中空系膜編織物の枚数、集水管の内径及び外径を考慮して $A/B$ の値を決定する。

【0030】本発明の中空系膜モジュールは以下に述べるような特徴がある。中空系膜を円形状若しくは同心円状に集束、配置した円筒形タイプのモジュールでは、取扱い性、特にモジュール装着時の作業性に優れる。中空系膜は面積Aで表される固定部材面全体に対して均等に配置されているため、面積Bが同じで $A/B$ が1のモジュールよりも中空系膜間への濁質の堆積や中空系膜同士の接着が生じ難くなり、膜面の有効利用並びにスクラビング洗浄が効率よく行われる。

【0031】また、同じ中空系膜本数のモジュールでも $A/B=1$ よりも $A/B>1$ のモジュールの方が固定部材として使用する樹脂が少量で作製できる。従って、硬化時に発熱するような樹脂の場合、できるだけ樹脂の量が少ない方が発熱も少なく、硬化収縮も小さくなり成形しやすくなる。

【0032】図2や図3の様な中空系膜編織物を用いた中空系膜モジュールでも同様の膜面積を有するモジュールよりも取扱い性に優れ、中空系膜編織物が層間隔を設けられて内外層に均等に配置されているので、膜面洗浄の際、中空系膜表面を均等に洗浄することが極めて容易となる。それぞれの中空系膜編織物の間隔を等間隔にすることでその効果が更に向上する。

【0033】複数のモジュールを処理槽等に配置する場合、特に中空系膜編織物を重ね合わせるように並列又は積層するような配置の場合、従来のモジュールでは、集

水管の外径又は集水管の濾液出口の接続部の大きさによってモジュール間隔が支配されている。

【0034】本発明のモジュールでは、固定部材の幅の方が集水管の外径や接続部よりも大きく、固定部材の側面同士が接するようにモジュールを並列させることによって、全てのモジュールに於ける全ての中空系膜編織物が等間隔で固定されるので、中空系膜全体に均等なスクラビング洗浄が行え、部分的な濾過効率の低下を招くことがない。

【0035】モジュール中の中空系膜編織物間の間隔は、スクラビング洗浄時のエアバブリングを膜面全体に均等に当てることを考慮すると、等間隔にすることが望ましいが、その間隔に於ては任意の距離が選択される。

【0036】エアバブリング等に於けるスクラビング洗浄の効率や隣接する中空系膜編織物の接着防止、及びモジュール当たりの膜面積等を考慮してシート間の距離を選択することができるが、好ましくは、5〜100mmの範囲が適当である。更に、中空系膜編織物を1枚毎所定の間隔を保って固定することにより、中空系膜同士の固着一体化をより防止することが可能となる。

【0037】中空系膜編織物を用いたモジュールでは図4のように中空系膜は開口端面の方へ向かって集束されているが、ここで中空系膜が固定部材内で完全に埋設されていることが望ましい。

【0038】特に中空系膜編織物を用いた平型の中空系膜モジュールの使用に於ては、モジュールを密閉容器に配設して、被処理水を加圧して中空系膜を透過させる所謂加圧濾過法も採用できるが、活性汚泥槽や沈殿槽等に中空系膜モジュールを配設し、中空系膜を透過した処理水を回収するサイドを吸引する吸引濾過法で使うことが好ましい。

【0039】特に、周期的に一時吸引を停止する、所謂間欠吸引運転方法を採用することにより、膜面堆積物が膜面内部へ入り込むのを効率的に防止することができる。中空系膜モジュールの機能回復処理頻度を低下させることができる。

【0040】間欠吸引の間欠間隔は、被処理水の汚濁度によって最適範囲は異なってくるが、明確な範囲は規定できないが、MLSS5000mg/L程度の活性汚泥を対象にする場合の例としては、吸引時間1〜30分、停止時間2秒〜15分の範囲を望ましい例として挙げる事ができる。

【0041】また、吸引濾過法を採用することにより、濾過時に処理水を槽内で循環させたり、エアバブリングを行って膜面を洗浄したりすることが行いやすくなる。特にエアバブリングによる洗浄方法は、上記に示したように、膜面堆積物が膜面内部へ入り込むのを効率的に防止することができる間欠吸引運転方法と組み合わせることによって、より一層の洗浄効果を発揮する。吸

引濾過法に於ける被処理水の流れは、中空糸膜の配設方向に対してほぼ垂直に流れるようにして、中空糸膜の膜面の洗浄効果をアップさせることが好ましい。

【0042】高汚濁水の濾過に於ては膜面に多くのssや有機物が堆積する。そのために、膜面を水流やエア、振動、超音波等を用いて堆積物を剥離させ洗浄する必要がある。洗浄を行わない場合には膜面に堆積した有機物が膜の閉塞の原因となり濾過寿命の低下を招く。具体的な洗浄方法としては、膜面に平行に水流を流す所謂クロスフロー濾過、膜モジュール浸漬槽にポンプ又はモーター等で水流を起こす方法、エアの上昇流を利用したバブリング法、モジュール自身を振動させる方法、被処理液を超音波により振動させる方法等が挙げられる。これらの洗浄は、膜面閉塞の進行具合に応じて、連続的に行っても良いし、断続的に行っても良い。

【0043】エアバブリングによるスクラビング洗浄を併用しながら運転する場合には、バブリングを行うための散気管が必要となる。適切なエアバブリングを行うためには散気管とモジュールの位置関係が重要であるが、モジュールと散気管を別々に固定するのは煩雑な作業であり、また、運転中にモジュールが移動してしまった場合、運転途中に於て適切なスクラビング洗浄が行うことができなくなる問題点がある。この対策として、本発明のモジュールに散気管を固定一体化することにより、缶体或は処理層への装着が容易になり、運転中に適切なスクラビング洗浄が継続できるようになる。

【0044】本発明の中空糸膜モジュールは、特に高汚濁水の濾過に適しており、具体的な利用分野としては、河川水の濾過、工業用水道水濾過、下排水の固液分離、排水処理（例えば合併浄化槽での処理）等が挙げられる。

【0045】

【発明の効果】本発明の中空糸膜モジュールは、大きい膜面積でありながらコンパクトな構造になっており、且つより多くの中空糸膜が直接被処理水と接触するので、中空糸膜間の固着一体化が防止され、特に高汚濁性水の濾過に於て、長期にわたって高い濾過効率を保つことが可能である。

【0046】特に中空糸膜編織物を用いた中空糸膜モジュールを処理槽内に浸漬して濾過を行う場合、全ての中空糸膜編織物を等間隔で配設することができ、複数のモジュール全体に均等な効率の良いスクラビング洗浄を実施できる。また、缶体あるいは処理槽への装着及び脱着が容易であり、取扱い性に優れている。

【図面の簡単な説明】

【図1】本発明の中空糸膜モジュールの一例を示す斜視図である。

【図2】本発明の中空糸膜モジュールの一例を示す斜視図である。

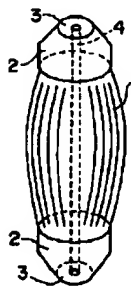
【図3】本発明の中空糸膜モジュールの一例を示す斜視図である。

【図4】本発明の中空糸膜モジュールの一例（図2及び図3）に於ける中空糸膜固定部の断面図である。

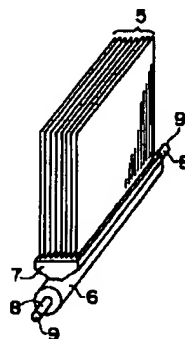
【符号の説明】

- 1 中空糸膜
- 2 ハウジング
- 3 中空糸膜開口端面
- 4 構造支持体
- 5 中空糸膜編織物
- 6 ハウジング及び集水管
- 7 固定部材
- 8 導水管
- 9 濾液取り出し口

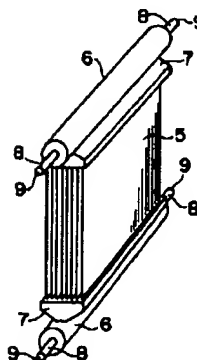
【図1】



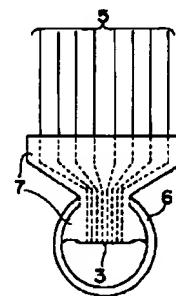
【図2】



【図3】



【図4】



## フロントページの続き

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION  
TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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[Translation done.]



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**CLAIMS**

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[Claim(s)]

[Claim 1] The hollow fiber module with which it is satisfied of a degree type when area of the holddown-member end face to which it is the hollow fiber module which it comes to fix, the one end section or the both ends of a hollow fiber maintaining an opening condition by the holddown member in housing, and A and a hollow fiber are carrying out opening of the area of the holddown-member side of the side which a hollow fiber exposes from a holddown member is set to B.

100  $\geq A/B \geq 1.2$  -- [Claim 2] The hollow fiber module with which it is satisfied of a degree type when it is fixed by the holddown member in structure material and area of the holddown-member end face to which A and a hollow fiber are carrying out opening of the area of the holddown-member side of the side which a hollow fiber exposes from a holddown member in the hollow fiber module with the long and slender configuration of a cross section perpendicular to the hollow fiber of a holddown member which is a rectangle mostly is set to B using a sheet-like hollow fiber knit fabric, the one end section or the both ends of the hollow fiber maintaining an opening condition.

100  $\geq A/B \geq 1.2$

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the hollow fiber module suitable for filtering the high liquid of especially corruption nature (corruption nature by the organic nature matter) about a hollow fiber module.

[0002]

[Description of the Prior Art] Conventionally, although many hollow fiber modules have been used in the so-called field of precision filtration, such as manufacture of non-bacterial water, potable water, and a high purity water, and purification of air, they are performed in recent years in the form with various examination used for high-polluted-water processing applications, such as secondary treatment in a sewage disposal plant, tertiary treatment, and solid liquid separation in a septic tank.

[0003] Since the blinding of the hollow fiber at the time of filtration processing is large, after fixed time amount filtration processing, the hollow fiber module used for such an application sends air, vibrates a hollow fiber, a film front face is washed, or repeats film surface washing of letting treated water flow to filtration processing and hard flow, and is performing it.

[0004] The shape of a circular circle for which the hollow fiber module used in these fields has been used in the field of the conventional precision filtration, and the cylindrical shape type thing which converged and has arranged the hollow fiber concentrically were almost the case. Moreover, though amelioration was performed, there was only much what changes the filling factor and restoration gestalt of a hollow fiber.

[0005]

[Problem(s) to be Solved by the Invention] When filtration processing of high polluted water (for example,  $ss \geq 50$  mg/L,  $TOC \geq 100$  mg/L) was performed using such a conventional hollow fiber module, by hollow fibers' fixing (adhesion) and unifying them through deposits, such as the organic substance which adhered to the hollow fiber front face with use, the effective film surface product of the hollow fiber in a module decreased, and the rapid fall of a filtration flow rate was seen. Moreover, it did in this way, and functional recovery of the module which once carried out the fixing unification of the hollow fiber module which hollow fibers fixed and unified also when periodical film surface washing and a periodical back wash were performed was not easy, and decline in washing effectiveness was seen.

[0006] It is the hollow fiber module which it comes to fix, changing to the hollow fiber module of a cylindrical shape with a focusing mold, arranging a hollow fiber in the shape of a sheet as a solution of this problem, and the one end section or the both ends of a hollow fiber maintaining an opening condition by the bridging in one or two different housing, respectively, and the long and slender hollow fiber module which is a rectangle mostly is propose for each configuration of a cross section perpendicular to the hollow fiber of a holddown member.

[0007] Since it becomes possible to prepare an interlayer spacing and to arrange a hollow fiber of such a hollow fiber module of a sheet-like flat tip equally in an inside-and-outside layer, and it becomes very easy to wash a hollow fiber front face equally in case it is film surface washing, it is a module suitable for filtration of high polluted water that decline in a filtration efficiency like the former can be suppressed etc.

[0008] Using the hollow fiber module of such a flat tip, to process mass (for example, 1m<sup>3</sup> / h) water, it is

necessary to extend a film surface product. When difficulty and a processing tub become large beyond the need and handling performs scrubbing washing etc. further by enlarging a modular film surface product, by increasing a film surface product, a hollow fiber will be accumulated and there is a trouble that the whole film surface in a module cannot be washed efficiently in Ayr etc.

[0009] Moreover, in use of the hollow fiber module of the conventional flat tip, although there is the approach of increasing and carrying out unitization of the number of modules in order to increase a film surface product, the module arrangement in a unit (namely, spacing of the inter module at the time of making a module arrange in parallel so that a sheet-like hollow fiber may be piled up) has a limitation in the path of catchment tubing of each module ruling over, and narrowing the distance of an inter module in this case.

[0010] Therefore, module spacing beyond the need (a sheet-like flat tip hollow fiber module spacing of a hollow fiber knit fabric) opens, and there is a trouble that the volume of a processing tub must become large beyond the need, or the amount of bubbling for scrubbing must be increased in connection with it.

[0011] Although this invention has a large film surface product in a compact module unit, the tooth space which the catchment section occupies is small, and scrubbing washing aims at offering the hollow fiber module which can be carried out efficiently to the whole hollow fiber in a module.

[0012]

[Means for Solving the Problem] The summary of this invention is as follows.

(1) The hollow fiber module with which it is satisfied of a degree type when area of the holddown-member end face to which it is the hollow fiber module which it comes to fix, the one end section or the both ends of a hollow fiber maintaining an opening condition by the holddown member in housing, and A and a hollow fiber are carrying out opening of the area of the holddown-member side of the side which a hollow fiber exposes from a holddown member is set to B.

$100 \geq A/B \geq 1.2$  [0013] (2) The hollow fiber module with which it is satisfied of a degree type when it is fixed by the holddown member in structure material and area of the holddown-member end face to which A and a hollow fiber are carrying out opening of the area of the holddown-member side of the side which a hollow fiber exposes from a holddown member in the hollow fiber module with the long and slender configuration of a cross section perpendicular to the hollow fiber of a holddown member which is a rectangle mostly is set to B using a sheet-like hollow fiber knit fabric, the one end section or the both ends of the hollow fiber maintaining an opening condition.

$100 \geq A/B \geq 1.2$  [0014] This invention is explained at a detail according to a drawing below. Drawing 1 is the perspective view of the hollow fiber module of this invention which fixed the both ends of a hollow fiber, maintaining opening by the holddown member, and formed the cylindrical shape. A/B of this module is 4.6. Drawing 2 is the perspective view of the hollow fiber module of this invention fixed by the holddown member eight sheets, maintaining an opening condition for the one end section of each hollow fiber using a hollow fiber knit fabric. A/B of this module is 1.7.

[0015] Drawing 3 is the perspective view of the hollow fiber module of this invention fixed by the holddown member eight sheets like drawing 2, maintaining an opening condition for the both ends of each hollow fiber using a hollow fiber knit fabric. Drawing 4 is the sectional view of the hollow filament fixed part in a direction perpendicular to the longitudinal direction of catchment tubing of the module shown by drawing 2 and drawing 3.

[0016] 1 -- a hollow fiber and 2 -- housing (the interior is a holddown member) and 3 -- a hollow fiber opening end face and 4 -- in housing and catchment tubing, and 7, a holddown member and 8 show a conduit tube and, as for structure supporting material and 5, 9 shows [ a hollow fiber knit fabric and 6 ] filtrate output port, respectively.

[0017] A hollow fiber 1 and the hollow fiber knit fabric 5 can use what consists of various ingredients, such as for example, a cellulose system, a polyolefine system, a polyvinyl alcohol system, and a polysulfone system, and its thing of the high quality of the materials of strong ductility, such as polyethylene and polypropylene, is especially desirable.

[0018] In addition, although there will be especially no limit in an aperture, a void content, thickness, and

an outer diameter if usable as a filtration membrane, considering a removal object, reservation of the film surface product per volume, the reinforcement of a hollow fiber, etc., as a desirable example, 0.01-1 micrometer of apertures, 20 - 90% of void contents, 5-300 micrometers of thickness, and the range of 20-2000-micrometer outer diameter can be mentioned. Moreover, the aperture in the case of aiming at removal of bacteria may use hundreds of thousands of ultrafiltration membrane from 10,000 cuts off molecular weight, when it becomes indispensable that it is 0.2 micrometers or less and it aims at removal of the organic substance or a virus.

[0019] It is desirable that it is the so-called lasting hydrophilization film which has a hydrophilic radical etc. in a front face as a surface characteristic of a hollow fiber. Well-known approaches, such as a method of manufacturing a hollow fiber with a hydrophilic macromolecule like a polyvinyl alcohol system as a process of the lasting hydrophilization film or the approach of carrying out hydrophilization of the front face of a hydrophobic poly membrane, can be used. For example, as an example of the hydrophilic giant molecule at the time of giving a hydrophilic giant molecule to a film surface and carrying out hydrophilization of the hydrophobic hollow fiber, an ethylene-vinyl acetate system copolymer saponification object, a polyvinyl pyrrolidone, etc. can be mentioned.

[0020] As an example of the film surface hydrophilization by another technique, there is a film surface polymerization method of a hydrophilic monomer, and diacetone acrylamide etc. can be mentioned as an example of this monomer. Moreover, as other technique, the approach of blending a hydrophilic giant molecule and carrying out spinning film production can be mentioned to a hydrophobic giant molecule (for example, polyolefine), and what was mentioned above as an example of the hydrophilic giant molecule to be used is mentioned.

[0021] A hydrophobic interaction works that a front face is a hydrophobic hollow fiber between the processed underwater organic substance and a hollow fiber front face, the organic substance adsorption to a film surface occurs, it leads to film surface lock out, and a filtration life becomes short. Moreover, generally the filtration-efficiency recovery by film surface washing is also difficult for the blinding of the adsorption origin.

[0022] If the lasting hydrophilization film is used, the hydrophobic interaction on the organic substance and the front face of a hollow fiber can be decreased, and adsorption of the organic substance can be suppressed. Furthermore, by the lasting hydrophilization film, although desiccation and hydrophobing arise and the fall of flux may be caused by the bubbling air in scrubbing washing in use by the hydrophobic film, even if it dries, the fall of flux is not caused.

[0023] As immobilization of a hollow fiber is shown in drawing 2 and drawing 3, either one end of a hollow fiber or both ends are OK. One of immobilization can be chosen according to the purpose or an application. The hollow fiber knit fabric 5 is an object which knit the hollow fiber in the shape of a sheet, and if equipment and the approach which the technique of arbitration is used as a process of a sheet-like hollow fiber, for example, are indicated by JP,4-26886,B and JP,63-91673,A are used, it can be manufactured easily.

[0024] Housing 2 functions as a member which fixes the hollow fiber focusing edge which has carried out resin immobilization. The hollow fiber opening end face 3 takes out filtrate from this end face, and sends filtrate to a conduit tube etc. The structure supporting material 4 is located in the core of a hollow fiber module, it is fixed with the wrap housing 2 and the resin fixed part currently formed in the both ends of the hollow fiber which converged is formed in one. In addition, the structure base material 4 of the shape of this rod can be made tubular, and the inside of that tubing can also be used as passage of water purification. As a cross-section configuration, if circular, a square, a rectangle, etc. are cylindrical, it will not interfere.

[0025] housing and the catchment tubing 6 function on the drawing 2 list as a member which supports the whole hollow fiber module of drawing 3 R> 3, and long and slender -- it has rectangular opening mostly. the configuration of the cross section where opening of this housing and the catchment tubing 6 is perpendicular to the hollow fiber of the holddown member by which restoration immobilization is carried out with a hollow fiber there is long and slender -- a rectangle is carried out mostly.

[0026] Although a holddown member 7 is formed in opening of housing and the catchment tubing 6 so that

it may have a cross-section configuration like drawing 3 while restoration immobilization is carried out, no matter a configuration may be what thing, it does not interfere. in order that this holddown member 7 may operate this hollow fiber as a filtration membrane while converging each edge of many hollow fibers, with an opening condition maintained and being fixed -- processed water and treated water -- liquid -- it functions as a member divided densely.

[0027] A holddown member 7 usually stiffens liquefied resin, such as an epoxy resin, an unsaturated polyester resin, and polyurethane, and is made to form. The same is said of the holddown member inside [ housing 2 ] drawing 1 . A conduit tube 8 is a pipe with which filtrate flows, and leads to filtrate output port 9.

[0028] Rigid-polyvinyl-chloride resin, a polycarbonate, polysulfone, polypropylene, acrylic resin, ABS plastics, conversion PPE resin, etc. are illustrated that what is necessary is just what has a mechanical strength and endurance as the quality of the material of housing 2, the structure supporting material 4, housing, the catchment tubing 6, and a conduit tube 8. It is desirable to make into the quality of the material after use, the resin of the hydrocarbon system which can carry out perfect combustion, without taking out a toxic gas by combustion, when incineration processing is required.

[0029] Although the ratio of the area B of the holddown-member end face in which the area A and the hollow fiber of a holddown-member side of the side which a hollow fiber exposes from a holddown member are carrying out opening, and  $A/B$  can choose any value, when the magnitude of processing capacity, a film surface product, a can, or a processing tub, handling nature, etc. are taken into consideration, the range of 1.2-100 is desirable. Especially, in the case of the hollow fiber module (a hollow fiber knit fabric is used) of a flat tip, the value of  $A/B$  is determined in consideration of the bore and outer diameter of the number of sheets of a hollow fiber knit fabric, and catchment tubing.

[0030] The hollow fiber module of this invention has the description which is described below. By the module of the cylindrical shape type which converged on a circle configuration or concentric circular, and has arranged the hollow fiber, it excels in handling nature, especially the workability at the time of module wearing. Since the hollow fiber is equally arranged to the whole holddown-member side expressed with area A, area B is the same,  $A/B$  stops easily being able to produce deposition of the suspended matter of a between [ hollow fibers ], and adhesion of hollow fibers rather than the module of 1, and scrubbing washing is efficiently performed in the deployment list of a film surface.

[0031] Moreover, rather than  $A/B=1$ , the module of the same hollow fiber number is also little, and the resin which the direction of the module of  $A/B>1$  uses as a holddown member can produce it. Therefore, in the case of resin which generates heat at the time of hardening, there is also little generation of heat, hardening contraction also becomes small, and it becomes easy to fabricate the direction with as much as possible few amounts of resin.

[0032] Since deal with it rather than the module which has the same film surface product, it excels in a sex, a hollow fiber knit fabric can prepare an interlayer spacing and the hollow fiber module using a hollow fiber knit fabric like drawing 2 or drawing 3 is also arranged equally at the inside-and-outside layer, it becomes very easy in the case of film surface washing to wash a hollow fiber front face equally. The effectiveness improves further by carrying out spacing of each hollow fiber knit fabric at equal intervals.

[0033] When arranging two or more modules to a processing tub etc., in juxtaposition or arrangement which carries out a laminating, by the conventional module, module spacing is governed by the magnitude of the connection of the outer diameter of catchment tubing, or the filtrate outlet of catchment tubing so that especially a hollow fiber knit fabric may be piled up.

[0034] By the module of this invention, the width of face of a holddown member is larger than the outer diameter and connection of catchment tubing, since all the hollow fiber knit fabrics in all modules are fixed at equal intervals by making a module arrange in parallel so that the side faces of a holddown member may touch, equal scrubbing washing can be performed to the whole hollow fiber, and decline in a partial filtration efficiency is not caused.

[0035] Although carrying out at equal intervals is desirable as for spacing between the hollow fiber knit fabrics in a module when it takes into consideration applying equally Ayr bubbling at the time of scrubbing

washing to the whole film surface, the distance of arbitration is chosen in the spacing.

[0036] Although the distance between sheets can be chosen in consideration of adhesion prevention of the effectiveness of scrubbing washing in Ayr bubbling etc., or an adjoining hollow fiber knit fabric, the film surface product per module, etc., the range of 5-100mm is suitable preferably. Furthermore, it becomes possible by maintaining predetermined spacing and fixing a hollow fiber knit fabric the whole sheet, to prevent fixing unification of hollow fibers more.

[0037] Although the hollow fiber is converging toward the direction of an opening end face like drawing 4 R> 4 by the module using a hollow fiber knit fabric, it is desirable to lay the hollow fiber underground completely within a holddown member here.

[0038] Although the so-called pressure filtration method arrange a module in a well-closed container, pressurize processed water in use of the hollow fiber module of the flat tip especially using a hollow fiber knit fabric, and make a hollow fiber penetrate is also employable, it is desirable to use it by the suction filtration method which attracts the side which collects the treated water which arranged the hollow fiber module in the activated sludge tank, the settling tank, etc., and penetrated the hollow fiber.

[0039] A film surface deposit can prevent entering inside a film surface efficiently by adopting the so-called intermittent suction operating method which stops suction periodically especially temporarily. The functional recovery frequency of a hollow fiber module can be reduced.

[0040] Although the clear range cannot be specified since intermittent spacing of intermittent suction changes with dirtiness of processed water in the optimal range, as an example in the case of being aimed at the active sludge of MLSS5000 mg/L extent, the range for 2 seconds - stop-time 15 minutes can be mentioned as a desirable example for the suction time amount 1 - 30 minutes.

[0041] Moreover, it becomes easy to perform circulating treated water within a tub at the time of filtration, or performing Ayr bubbling and washing a film surface by adopting a suction filtration method. The washing approach especially by Ayr bubbling demonstrates much more cleaning effect by combining with the intermittent suction operating method to which a film surface deposit can prevent entering inside a film surface efficiently, as shown above. As for the flow of the processed water in a suction filtration method, it is desirable to make the cleaning effect of the film surface of a hollow fiber raise, as it flows almost perpendicularly to the arrangement direction of a hollow fiber.

[0042] Many ss(es) and the organic substance accumulate on a film surface in filtration of high corruption water. Therefore, a deposit is made to exfoliate using a stream, Ayr, vibration, a supersonic wave, etc., and it is necessary to wash a film surface. In not washing, the organic substance deposited on the film surface causes [ membranous ] lock out, and causes the fall of a filtration life. The so-called cross flow filtration which passes a stream in parallel with a film surface as the concrete washing approach, the method of causing a stream by the pump or the motor to a membrane module immersion tub, the bubbling method using the upflow of Ayr, the method of vibrating the module itself, the method of vibrating a processed liquid with a supersonic wave, etc. are mentioned. These washing may be continuously performed according to the advance condition of film surface lock out, and you may carry out intermittently.

[0043] In operating using together scrubbing washing by Ayr bubbling, the powder trachea for performing bubbling is needed. In order to perform suitable Ayr bubbling, the physical relationship of a powder trachea and a module is important, but a complicated activity fixes a module and a powder trachea separately, and when the module has moved during operation, it has the trouble it becomes impossible for scrubbing washing suitable in the middle of operation to perform. As this cure, by carrying out the fixed unification of the powder trachea at the module of this invention, wearing in a can or a processing layer becomes easy, and scrubbing washing suitable during operation can be continued now.

[0044] Especially the hollow fiber module of this invention fits filtration of high corruption water, and the solid liquid separation of filtration of river water, industrial-water-works water filtration, and bottom wastewater, waste water treatment (for example, processing in a union septic tank), etc. are mentioned as a concrete field of the invention.

[0045]

[Effect of the Invention] Though it is a large film surface product, since it has compact structure and more

hollow fibers contact direct processed water, the fixing unification between hollow fibers is prevented and the hollow fiber module of this invention can maintain [ in / especially / filtration of high polluted water ] a high filtration efficiency over a long period of time.

[0046] When filtering the hollow fiber module especially using a hollow fiber knit fabric by being immersed in a processing tub, all hollow fiber knit fabrics can be arranged at equal intervals, and scrubbing washing with the equal sufficient effectiveness to two or more whole modules can be carried out. Moreover, wearing to a can or a processing tub and desorption are easy, and it excels in handling nature.

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**TECHNICAL FIELD**

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[Industrial Application] This invention relates to the hollow fiber module suitable for filtering the high liquid of especially corruption nature (corruption nature by the organic nature matter) about a hollow fiber module.

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**PRIOR ART**

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[Description of the Prior Art] Conventionally, although many hollow fiber modules have been used in the so-called field of precision filtration, such as manufacture of non-bacterial water, potable water, and a high purity water, and purification of air, they are performed in recent years in the form with various examination used for high-polluted-water processing applications, such as secondary treatment in a sewage disposal plant, tertiary treatment, and solid liquid separation in a septic tank.

[0003] Since the blinding of the hollow fiber at the time of filtration processing is large, after fixed time amount filtration processing, the hollow fiber module used for such an application sends air, vibrates a hollow fiber, a film front face is washed, or repeats film surface washing of letting treated water flow to filtration processing and hard flow, and is performing it.

[0004] The shape of a circular circle for which the hollow fiber module used in these fields has been used in the field of the conventional precision filtration, and the cylindrical shape type thing which converged and has arranged the hollow fiber concentrically were almost the case. Moreover, though amelioration was performed, there was only much what changes the filling factor and restoration gestalt of a hollow fiber.

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**EFFECT OF THE INVENTION**

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[Effect of the Invention] Though it is a large film surface product, since it has compact structure and more hollow fibers contact direct processed water, the fixing unification between hollow fibers is prevented and the hollow fiber module of this invention can maintain [ in / especially / filtration of high polluted water ] a high filtration efficiency over a long period of time.

[0046] When filtering the hollow fiber module especially using a hollow fiber knit fabric by being immersed in a processing tub, all hollow fiber knit fabrics can be arranged at equal intervals, and scrubbing washing with the equal sufficient effectiveness to two or more whole modules can be carried out. Moreover, wearing to a can or a processing tub and desorption are easy, and it excels in handling nature.

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## **TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] When filtration processing of high polluted water (for example,  $ss \geq 50$  mg/L,  $TOC \geq 100$  mg/L) was performed using such a conventional hollow fiber module, by hollow fibers' fixing (adhesion) and unifying them through deposits, such as the organic substance which adhered to the hollow fiber front face with use, the effective film surface product of the hollow fiber in a module decreased, and the rapid fall of a filtration flow rate was seen. Moreover, it did in this way, and functional recovery of the module which once carried out the fixing unification of the hollow fiber module which hollow fibers fixed and unified also when periodical film surface washing and a periodical back wash were performed was not easy, and decline in washing effectiveness was seen.

[0006] It is the hollow fiber module which it comes to fix, changing to the hollow fiber module of a cylindrical shape with a focusing mold, arranging a hollow fiber in the shape of a sheet as a solution of this problem, and the one end section or the both ends of a hollow fiber maintaining an opening condition by the bridging in one or two different housing, respectively, and the long and slender hollow fiber module which is a rectangle mostly is propose for each configuration of a cross section perpendicular to the hollow fiber of a holddown member.

[0007] Since it becomes possible to prepare an interlayer spacing and to arrange a hollow fiber of such a hollow fiber module of a sheet-like flat tip equally in an inside-and-outside layer, and it becomes very easy to wash a hollow fiber front face equally in case it is film surface washing, it is a module suitable for filtration of high polluted water that decline in a filtration efficiency like the former can be suppressed etc.

[0008] Using the hollow fiber module of such a flat tip, to process mass (for example,  $1\text{ m}^3 / \text{h}$ ) water, it is necessary to extend a film surface product. When difficulty and a processing tub become large beyond the need and handling performs scrubbing washing etc. further by enlarging a modular film surface product, by increasing a film surface product, a hollow fiber will be accumulated and there is a trouble that the whole film surface in a module cannot be washed efficiently in Ayr etc.

[0009] Moreover, in use of the hollow fiber module of the conventional flat tip, although there is the approach of increasing and carrying out unitization of the number of modules in order to increase a film surface product, the module arrangement in a unit (namely, spacing of the inter module at the time of making a module arrange in parallel so that a sheet-like hollow fiber may be piled up) has a limitation in the path of catchment tubing of each module ruling over, and narrowing the distance of an inter module in this case.

[0010] Therefore, module spacing beyond the need (a sheet-like flat tip hollow fiber module spacing of a hollow fiber knit fabric) opens, and there is a trouble that the volume of a processing tub must become large beyond the need, or the amount of bubbling for scrubbing must be increased in connection with it.

[0011] Although this invention has a large film surface product in a compact module unit, the tooth space which the catchment section occupies is small, and scrubbing washing aims at offering the hollow fiber module which can be carried out efficiently to the whole hollow fiber in a module.

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**MEANS**

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[Means for Solving the Problem] The summary of this invention is as follows.

(1) The hollow fiber module with which it is satisfied of a degree type when area of the holddown-member end face to which it is the hollow fiber module which it comes to fix, the one end section or the both ends of a hollow fiber maintaining an opening condition by the holddown member in housing, and A and a hollow fiber are carrying out opening of the area of the holddown-member side of the side which a hollow fiber exposes from a holddown member is set to B.

$100 \geq A/B \geq 1.2$  [0013] (2) The hollow fiber module with which it is satisfied of a degree type when it is fixed by the holddown member in structure material and area of the holddown-member end face to which A and a hollow fiber are carrying out opening of the area of the holddown-member side of the side which a hollow fiber exposes from a holddown member in the hollow fiber module with the long and slender configuration of a cross section perpendicular to the hollow fiber of a holddown member which is a rectangle mostly is set to B using a sheet-like hollow fiber knit fabric, the one end section or the both ends of the hollow fiber maintaining an opening condition.

$100 \geq A/B \geq 1.2$  [0014] This invention is explained at a detail according to a drawing below. Drawing 1 is the perspective view of the hollow fiber module of this invention which fixed the both ends of a hollow fiber, maintaining opening by the holddown member, and formed the cylindrical shape. A/B of this module is 4.6. Drawing 2 is the perspective view of the hollow fiber module of this invention fixed by the holddown member eight sheets, maintaining an opening condition for the one end section of each hollow fiber using a hollow fiber knit fabric. A/B of this module is 1.7.

[0015] Drawing 3 is the perspective view of the hollow fiber module of this invention fixed by the holddown member eight sheets like drawing 2, maintaining an opening condition for the both ends of each hollow fiber using a hollow fiber knit fabric. Drawing 4 is the sectional view of the hollow filament fixed part in a direction perpendicular to the longitudinal direction of catchment tubing of the module shown by drawing 2 and drawing 3.

[0016] 1 -- a hollow fiber and 2 -- housing (the interior is a holddown member) and 3 -- a hollow fiber opening end face and 4 -- in housing and catchment tubing, and 7, a holddown member and 8 show a conduit tube and, as for structure supporting material and 5, 9 shows [ a hollow fiber knit fabric and 6 ] filtrate output port, respectively.

[0017] A hollow fiber 1 and the hollow fiber knit fabric 5 can use what consists of various ingredients, such as for example, a cellulose system, a polyolefine system, a polyvinyl alcohol system, and a polysulfone system, and its thing of the high quality of the materials of strong ductility, such as polyethylene and polypropylene, is especially desirable.

[0018] In addition, although there will be especially no limit in an aperture, a void content, thickness, and an outer diameter if usable as a filtration membrane, considering a removal object, reservation of the film surface product per volume, the reinforcement of a hollow fiber, etc., as a desirable example, 0.01-1 micrometer of apertures, 20 - 90% of void contents, 5-300 micrometers of thickness, and the range of 20-2000-micrometer outer diameter can be mentioned. Moreover, the aperture in the case of aiming at removal of bacteria may use hundreds of thousands of ultrafiltration membrane from 10,000 cuts off molecular weight, when it becomes indispensable that it is 0.2 micrometers or less and it aims at removal of the

organic substance or a virus.

[0019] It is desirable that it is the so-called lasting hydrophilization film which has a hydrophilic radical etc. in a front face as a surface characteristic of a hollow fiber. Well-known approaches, such as a method of manufacturing a hollow fiber with a hydrophilic macromolecule like a polyvinyl alcohol system as a process of the lasting hydrophilization film or the approach of carrying out hydrophilization of the front face of a hydrophobic poly membrane, can be used. For example, as an example of the hydrophilic giant molecule at the time of giving a hydrophilic giant molecule to a film surface and carrying out hydrophilization of the hydrophobic hollow fiber, an ethylene-vinyl acetate system copolymer saponification object, a polyvinyl pyrrolidone, etc. can be mentioned.

[0020] As an example of the film surface hydrophilization by another technique, there is a film surface polymerization method of a hydrophilic monomer, and diacetone acrylamide etc. can be mentioned as an example of this monomer. Moreover, as other technique, the approach of blending a hydrophilic giant molecule and carrying out spinning film production can be mentioned to a hydrophobic giant molecule (for example, polyolefine), and what was mentioned above as an example of the hydrophilic giant molecule to be used is mentioned.

[0021] A hydrophobic interaction works that a front face is a hydrophobic hollow fiber between the processed underwater organic substance and a hollow fiber front face, the organic substance adsorption to a film surface occurs, it leads to film surface lock out, and a filtration life becomes short. Moreover, generally the filtration-efficiency recovery by film surface washing is also difficult for the blinding of the adsorption origin.

[0022] If the lasting hydrophilization film is used, the hydrophobic interaction on the organic substance and the front face of a hollow fiber can be decreased, and adsorption of the organic substance can be suppressed. Furthermore, by the lasting hydrophilization film, although desiccation and hydrophobing arise and the fall of flux may be caused by the bubbling air in scrubbing washing in use by the hydrophobic film, even if it dries, the fall of flux is not caused.

[0023] As immobilization of a hollow fiber is shown in drawing 2 and drawing 3, either one end of a hollow fiber or both ends are OK. One of immobilization can be chosen according to the purpose or an application. The hollow fiber knit fabric 5 is an object which knit the hollow fiber in the shape of a sheet, and if equipment and the approach which the technique of arbitration is used as a process of a sheet-like hollow fiber, for example, are indicated by JP,4-26886,B and JP,63-91673,A are used, it can be manufactured easily.

[0024] Housing 2 functions as a member which fixes the hollow fiber focusing edge which has carried out resin immobilization. The hollow fiber opening end face 3 takes out filtrate from this end face, and sends filtrate to a conduit tube etc. The structure supporting material 4 is located in the core of a hollow fiber module, it is fixed with the wrap housing 2 and the resin fixed part currently formed in the both ends of the hollow fiber which converged is formed in one. In addition, the structure base material 4 of the shape of this rod can be made tubular, and the inside of that tubing can also be used as passage of water purification. As a cross-section configuration, if circular, a square, a rectangle, etc. are cylindrical, it will not interfere.

[0025] housing and the catchment tubing 6 function on the drawing 2 list as a member which supports the whole hollow fiber module of drawing 3 R> 3, and long and slender -- it has rectangular opening mostly. the configuration of the cross section where opening of this housing and the catchment tubing 6 is perpendicular to the hollow fiber of the holddown member by which restoration immobilization is carried out with a hollow fiber there is long and slender -- a rectangle is carried out mostly.

[0026] Although a holddown member 7 is formed in opening of housing and the catchment tubing 6 so that it may have a cross-section configuration like drawing 3 while restoration immobilization is carried out, no matter a configuration may be what thing, it does not interfere. in order that this holddown member 7 may operate this hollow fiber as a filtration membrane while converging each edge of many hollow fibers, with an opening condition maintained and being fixed -- processed water and treated water -- liquid -- it functions as a member divided densely.

[0027] A holddown member 7 usually stiffens liquefied resin, such as an epoxy resin, an unsaturated

polyester resin, and polyurethane, and is made to form. The same is said of the holddown member inside [ housing 2 ] drawing 1 . A conduit tube 8 is a pipe with which filtrate flows, and leads to filtrate output port 9.

[0028] Rigid-polyvinyl-chloride resin, a polycarbonate, polysulfone, polypropylene, acrylic resin, ABS plastics, conversion PPE resin, etc. are illustrated that what is necessary is just what has a mechanical strength and endurance as the quality of the material of housing 2, the structure supporting material 4, housing, the catchment tubing 6, and a conduit tube 8. It is desirable to make into the quality of the material after use, the resin of the hydrocarbon system which can carry out perfect combustion, without taking out a toxic gas by combustion, when incineration processing is required.

[0029] Although the ratio of the area B of the holddown-member end face in which the area A and the hollow fiber of a holddown-member side of the side which a hollow fiber exposes from a holddown member are carrying out opening, and  $A/B$  can choose any value, when the magnitude of processing capacity, a film surface product, a can, or a processing tub, handling nature, etc. are taken into consideration, the range of 1.2-100 is desirable. Especially, in the case of the hollow fiber module (a hollow fiber knit fabric is used) of a flat tip, the value of  $A/B$  is determined in consideration of the bore and outer diameter of the number of sheets of a hollow fiber knit fabric, and catchment tubing.

[0030] The hollow fiber module of this invention has the description which is described below. By the module of the cylindrical shape type which converged on a circle configuration or concentric circular, and has arranged the hollow fiber, it excels in handling nature, especially the workability at the time of module wearing. Since the hollow fiber is equally arranged to the whole holddown-member side expressed with area A, area B is the same,  $A/B$  stops easily being able to produce deposition of the suspended matter of a between [ hollow fibers ], and adhesion of hollow fibers rather than the module of 1, and scrubbing washing is efficiently performed in the deployment list of a film surface.

[0031] Moreover, rather than  $A/B=1$ , the module of the same hollow fiber number is also little, and the resin which the direction of the module of  $A/B>1$  uses as a holddown member can produce it. Therefore, in the case of resin which generates heat at the time of hardening, there is also little generation of heat, hardening contraction also becomes small, and it becomes easy to fabricate the direction with as much as possible few amounts of resin.

[0032] Since deal with it rather than the module which has the same film surface product, it excels in a sex, a hollow fiber knit fabric can prepare an interlayer spacing and the hollow fiber module using a hollow fiber knit fabric like drawing 2 or drawing 3 is also arranged equally at the inside-and-outside layer, it becomes very easy in the case of film surface washing to wash a hollow fiber front face equally. The effectiveness improves further by carrying out spacing of each hollow fiber knit fabric at equal intervals.

[0033] When arranging two or more modules to a processing tub etc., in juxtaposition or arrangement which carries out a laminating, by the conventional module, module spacing is governed by the magnitude of the connection of the outer diameter of catchment tubing, or the filtrate outlet of catchment tubing so that especially a hollow fiber knit fabric may be piled up.

[0034] By the module of this invention, the width of face of a holddown member is larger than the outer diameter and connection of catchment tubing, since all the hollow fiber knit fabrics in all modules are fixed at equal intervals by making a module arrange in parallel so that the side faces of a holddown member may touch, equal scrubbing washing can be performed to the whole hollow fiber, and decline in a partial filtration efficiency is not caused.

[0035] Although carrying out at equal intervals is desirable as for spacing between the hollow fiber knit fabrics in a module when it takes into consideration applying equally Ayr bubbling at the time of scrubbing washing to the whole film surface, the distance of arbitration is chosen in the spacing.

[0036] Although the distance between sheets can be chosen in consideration of adhesion prevention of the effectiveness of scrubbing washing in Ayr bubbling etc., or an adjoining hollow fiber knit fabric, the film surface product per module, etc., the range of 5-100mm is suitable preferably. Furthermore, it becomes possible by maintaining predetermined spacing and fixing a hollow fiber knit fabric the whole sheet, to prevent fixing unification of hollow fibers more.

[0037] Although the hollow fiber is converging toward the direction of an opening end face like drawing 4 R> 4 by the module using a hollow fiber knit fabric, it is desirable to lay the hollow fiber underground completely within a holddown member here.

[0038] Although the so-called pressure filtration method arrange a module in a well-closed container, pressurize processed water in use of the hollow fiber module of the flat tip especially using a hollow fiber knit fabric, and make a hollow fiber penetrate is also employable, it is desirable to use it by the suction filtration method which attracts the side which collects the treated water which arranged the hollow fiber module in the activated sludge tank, the settling tank, etc., and penetrated the hollow fiber.

[0039] A film surface deposit can prevent entering inside a film surface efficiently by adopting the so-called intermittent suction operating method which stops suction periodically especially temporarily. The functional recovery frequency of a hollow fiber module can be reduced.

[0040] Although the clear range cannot be specified since intermittent spacing of intermittent suction changes with dirtiness of processed water in the optimal range, as an example in the case of being aimed at the active sludge of MLSS5000 mg/L extent, the range for 2 seconds - stop-time 15 minutes can be mentioned as a desirable example for the suction time amount 1 - 30 minutes.

[0041] Moreover, it becomes easy to perform circulating treated water within a tub at the time of filtration, or performing Ayr bubbling and washing a film surface by adopting a suction filtration method. The washing approach especially by Ayr bubbling demonstrates much more cleaning effect by combining with the intermittent suction operating method to which a film surface deposit can prevent entering inside a film surface efficiently, as shown above. As for the flow of the processed water in a suction filtration method, it is desirable to make the cleaning effect of the film surface of a hollow fiber raise, as it flows almost perpendicularly to the arrangement direction of a hollow fiber.

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[0045]

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

[Drawing 1] It is the perspective view showing an example of the hollow fiber module of this invention.

[Drawing 2] It is the perspective view showing an example of the hollow fiber module of this invention.

[Drawing 3] It is the perspective view showing an example of the hollow fiber module of this invention.

[Drawing 4] It is the sectional view of the hollow fiber fixed part in an example ( drawing 2 and drawing 3 ) of the hollow fiber module of this invention.

**[Description of Notations]**

1 Hollow Fiber

2 Housing

3 Hollow Fiber Opening End Face

4 Structure Base Material

5 Hollow Fiber Knit Fabric

6 Housing and Catchment Tubing

7 Holddown Member

8 Conduit Tube

9 Filtrate Output Port

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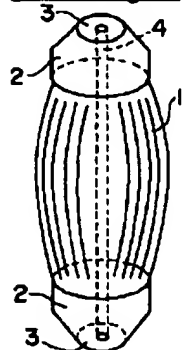
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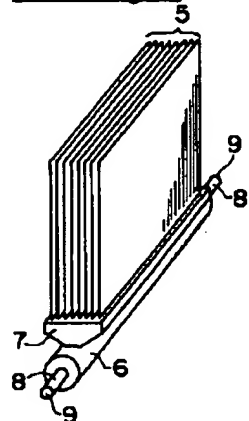
**DRAWINGS**

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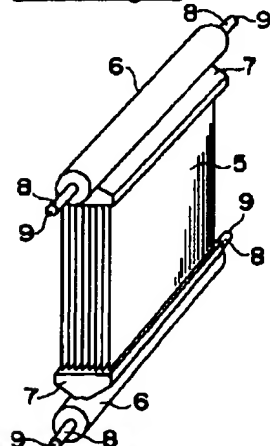
[Drawing 1]



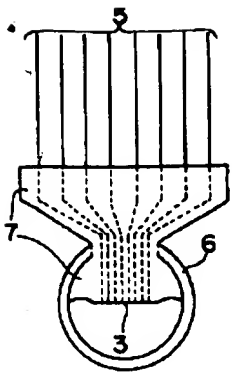
[Drawing 2]



[Drawing 3]



[Drawing 4]



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[Translation done.]